DESCRIPTION OF MAJOR PROJECTS

for

COMMIUNICATIONS, NAVIGATION and SURVEILLANCE SYSTEMS

Task: Traffic Alert and Collision Avoidance System (TCAS)
Support

The Volpe Center has been providing ongoing program support to
the Federal Aviation Administration (FAA) for the verification
and validation of the Traffic Alert and Collision Avoidance
System (TCAS). To perform this task, personnel provide
expertise in:

• identifying system and subsystem requirements
• formal specification methods and analysis as applied to these
  requirements
• test generation based on 100 percent coverage of requirements
• airborne radar surveillance
• airborne EMI environments typical of the 1030/1090 Mhz region
• civil and military transponder characteristics
• displays and display technology
• system level characterization and analysis for complex
  computer-based avionic systems.

Personnel are required to have in-depth experience and
capabilities in the development of formal requirements for and
the validation and verification of complex avionics and
surveillance systems. In addition, prior experience and
expertise in the following areas is desirable:

• comprehensive experience and expertise in working with
  complex distributed real-time computer systems

• knowledge of FAA air traffic control system functions

• knowledge of performance limits and capabilities for turbine-
  powered aircraft

• familiarity with airborne secondary radar systems and the EMI
  environment for aircraft systems

• demonstrated expertise in the areas of display technology and
  the presentation of aural and visual information to flight
  crews

• prior experience in the development and documentation of
  aviation standards for complex avionic systems

Task: FAA Special Programs Integration Support

The Volpe Center is providing support to the Federal Aviation
Administration (FAA) through the National Airspace System (NAS)
Transition and Implementation Service (ANS). The Center
provides integration and implementation support to ANS for the
modernization of CNS services, systems, equipment, and
facilities. This task will provide support to ANS in the
following areas:

- development of all necessary plans required to carry out
  governmental steps for implementing major CNS services,
  systems, facilities, and/or equipment

- perform comprehensive system analyses

- development of all necessary plans for dealing with the
  non-technical factors integral to a CNS task

- develop cost/benefit analyses for CNS services, systems,
  facilities and/or equipment

- performing Cost and Operational Effectiveness Analyses
  (COEA) for determination of best alternative among various
  CNS options

- examination of major system architecture/implementation
  approaches as an integration of CNS functions for more
  effective utilization of system resources

Support also includes:

- development, update, analysis, and evaluation of plans and
  schedules through precedence network modeling and the
  computer-based project management tool named ARTEMIS

- development of Operational Transition Plans, Program
  Management Plans, Charters and System Architecture
  Documents for ANS special programs

- development of equipment/systems requirements and
  transition issues for ANS special programs

Task: Intermodal Data Network Support

The Office of the Secretary, Office of Information Resource
Management, for the Department of Transportation (DOT) is
responsible for the full life cycle development of a data
communications network located at the DOT's three major
Headquarters buildings (Nassif, FB 10A, and Transpoint) in
Washington, DC. This network, the Intermodal Data Network (IDN)
uses the Fiber Distributed Data Interface (FDDI) standard to
connect multiple networks across a common fiber ring. All DOT
operating administrations are actively transitioning to the IDN.

The Volpe Center was responsible for the development and design
of the IDN, and has supported the Office of Information Resource
Management in its subsequent installation. This task will
provide technical and analytical support for improving and
expanding operation of the IDN. This support includes the
following components of the IDN:

- The fiber optic cabling system in the Nassif Building
  which includes fiber cable, the fiber optic patch panel,
  fiber optic connectors, and fiber optic patch cables.

- The FDDI-to-Ethernet bridges/routers in the Nassif
  Building used to connect it with Transpoint and FB 10A.

- The 10BASE-T concentrators/hubs, multiple media chassis
  devices, and repeater modules in the Nassif Building that
  connect directly to the FDDI-to- Ethernet bridges and
  which are used to interconnect several different Local
  Area Network environments to a specific bridge/router
  port.

- Gateways, bridge/routers, modems, servers, and
  workstations associated with shared IDN services provided
  in the Nassif Building to include X.400 electronic mail
  exchange, Internet access, and leased communication links
  to Cambridge, MA, and Oklahoma City, OK.

- Network management devices and software that are used to
  monitor, configure or otherwise evaluate and change
  performance parameters on devices described above.

Task: National Airspace System (NAS) System Engineering Process Development

The Volpe Center has supported the Federal Aviation Administration's (FAA) National Airspace System (NAS) System Engineering Service (ASE) on many projects. In broad terms, NAS refers to all facilities, equipment, services, and people that must be provided to assure safe movement of people and property through the physical airspace above the territory of the United States and in accordance with international agreements. This includes services provided by air traffic control (ATC) and airport facilities through the interactions of people and equipment.

The objective of this task is to provide ASE with technical support in the following areas:

- improvement of the FAA's system engineering process

- improvement of the description of the NAS

- ensuring needed user services are provided by the evolving NAS.

In-depth experience and capabilities in system engineering for complex systems will be provided as well as prior knowledge, experience and expertise in the following areas:

- state-of-the-art system engineering principles and practices

- FAA ATC systems

- NAS documentation

- FAA ATC functional configuration

- FAA ATC physical configuration

- FAA research, engineering, and development plan projects

- FAA Capital Investment Plan projects

Task: Support for Navigation, Landing, and Surveillance System
Engineering

The Volpe Center is supporting the Federal Aviation
Administration (FAA) in the modernization of the Air Traffic
Control (ATC) system to meet the air transportation requirements
into the 21st century. The modernization effort has been spurred
by the need to replace aging equipment, achieve greater
efficiency through automation, and facilitate more information
sharing between air and ground systems by means of digital data
link.

The modernization process is proceeding along two tracks. While
new systems with proven technologies are being fielded (such as
a new generation of a solid state Instrument Landing System
(ILS), Airport Surface Detection Equipment-3 (ASDE)), other
systems are being development by intensely exploiting existing
technologies (such as Microwave Landing System (MLS), Mode-S
Secondary Surveillance Radar (SSR)) or through incorporating
emergent technologies. In the latter category, one that stands
out is the emergent satellite technology whose exploitation has
only just begun. Critical to realizing the full benefits of the
satellite technology will be the system engineering process that
includes assessing the operational requirements, identifying
satellite-integrated ATC system architectures and choosing an
optimum architecture, and mapping operational requirements to
ATC functions and services for the selected architecture.

Future applications of the systems engineering process will be
in assessing and charting the evolution of the ATC system from a
partial satellite-integrated ATC system to a sole means
satellite system, including satellite-based communications.

This task will provide support in charting the evolution of the
ATC system and defining the optimum mix of elements for each
phase in the ATC system evolution. A number of automation
technologies, such as Advanced Automation System (AAS), Terminal
Air Traffic Control Automation (TATCA), Automated En Route Air
Traffic Control (AERA), Mode S, Traffic Alert and Collision
Avoidance Systems (TCAS) are expected to be infused in the
evolutionary process. From the perspective of systems
engineering, work will be performed for each phase of ATC system
evolution operational requirements analyses, high level system
design and subsystem function allocation, issues analyses, and
economic feasibility analysis.

Task: Airport Surface Traffic Automation Program Engineering
Support

The Volpe Center is supporting the Federal Aviation
Administration (FAA) in the design, development, and
implementation of the various systems which are part of the
FAA's Airport Surface Traffic Automation (ASTA) Program. The
systems are designed to address both airport safety and capacity
issues. Typical of the systems being developed are the
following:

- Runway Status Light System (RSLS) which consists of red
  lights located at the intersection of taxiways and runways
  and at the runway take-off positions to alert pilots of
  runway occupancy conflict

- Airport Movement Area Safety System (AMASS) which when
  integrated with the Airport Surface Detection Equipment
  (ASDE3) radar provides conflict alert information to the
  ground controllers

- Low cost alternatives to the ASDE3/AMASS which might be
  deployed at airports not scheduled to receive ASDE3

- The umbrella ASTA system which would include ASDE3/AMASS
  and provide identification and position of all vehicles on
  the airport movement area

The nature of this task is to support effort the FAA by:

- Assisting in the preparation of various programmatic
  documents such as operational concept, acquisition plans,
  alternative analysis, and requests for proposal comprising
  the statement of work and system specifications

- Conducting system design, development, implementation, and
  test activities of ASTA-related systems

- Evaluation of hardware and software systems designated as
  ASTA related

- Evaluation of technologies and their implementations to
  determine applicability to the ASTA program

- Conducting studies and analyses which would serve as a
  basis for FAA decisions concerning ASTA and ASTA-related
  systems

Task: FAA Frequency Management Support

The Volpe Center is providing technical and management support to the Federal Aviation Administration's (FAA) Spectrum Policy and Management System (ASR) in a wide variety of areas dealing with frequency allocations for new aviation systems, determination of the causes of frequency interference, and resolution of issues which arise due to frequency spectrum scarcity.

Support under this task may consist of:

- spectrum modeling and simulation

- modeling and simulation of various avionics equipment and ground stations

- determination of the exact interference mechanisms

- evaluation of potential solution

- investigations of intentional interference involving the evaluation of the vulnerability of the Global Positioning Systems (GPS) to international jamming

- vulnerability analysis and modeling of GPS receiver operation, investigation of anti-jam measures, and UHF/VHF air-to-ground communications

Task: Ocean Separation Standards Program Engineering Support

The United States is participating in an effort to reduce the required high altitude vertical separation between trans-Atlantic aircraft from 2,000 to 1,000 feet. Once implemented, the new separation standard is expected to provide more fuel efficient routings and an overall increase in North Atlantic system capacity. It has been determined necessary to monitor aircraft height-keeping performance before actual implementation of the reduced vertical separation minimum to ensure that requirements on equipment and procedures can be met and that acceptable vertical position keeping can be realized.

The United States has conducted an exploratory evaluation of the potential use of post-processed, differentially corrected Global Position System (GPS) information to estimate the height of aircraft in the North Atlantic airspace. Vertical position monitoring units based on the GPS have been developed. These units, called GPS Monitoring Units (GMUs), have been flown on commercial airliners, business jets, and military aircraft traversing the North Atlantic, and the reduced data indicates that this is an acceptable monitoring method.

The Volpe Center is supporting the Federal Aviation Administration (FAA) in the continuation of the data gathering and processing activities. This task will assemble additional GMUs to enable acceleration of the process and will support the FAA in the new standards approval process and associated international activities. This task will also ensure that the ground-based systems are operational and ready to initiate the data acquisition activities.

Task: Weather Sensor Systems Support

The Volpe Center provides weather and atmospheric sensor and system-related support to the Federal Aviation Administration (FAA) and to the Air Force's Phillips Laboratory/Geophysics Directorate.

In support of the FAA, this task consists of:

- Providing technical support for the production and deployment of the Automated Weather Observing System (AWOS)

- Developing an end-to-end demonstration of the lightening detection/reporting process for the FAA's AWOS Automated Surface Observing System (ASOS)

- Providing technical expertise on the contents, requirements, and characteristics of several Interface Control Documents (ICDs) which describe the physical and logical interfaces between the AWOS Data Acquisition System (ADAS) and the external elements of the FAA/National Weather System (NWS) information network.

- Testing of icing resistant wind sensors for the FAA's Low Level Windshear Alert System (LLWAS) which issues an alert whenever it detects hazardous windshear conditions

- Developing and testing a number of advisory and sensing systems for the Wake Vortex Program

In support of the Air Force, this task consists of:

- Providing software engineering support on the delineation and implementation of mathematical algorithms in cloud physics and optic models, data retrieval and analysis, and database refinement for the Global Weather Central real-time cloud layer analysis model.

- Maintaining a site dedicated to the evaluation of weather sensor technology as well as maintaining various reference sensors for the major meteorological parameters along with weather observations taken at the site

Task: System Engineering for the National Airspace System in the Terminal Area

The Volpe Center supports the Federal Aviation Administration's (FAA) System Engineering Services (SES) on many projects. This task assists the SES with:

- a variety of technical areas (i.e., telecommunications, primary and secondary surveillance systems, precision landing systems)

- the horizontal integration of equipment built to support these technical disciplines

- the operation of this equipment within the National Airspace System (NAS)

Support has included a wide range of activities such as:

- support of the Chief NAS system engineer and mission needs analysis

- benefit-cost studies of research, engineering, and development projects for the FAA's Operations Research Service (AOR-100)

- support of the system design review team

Task: Facility System Engineering Support

The Federal Aviation Administration's (FAA) Facility System Engineering Service (AFE) is responsible for the design and planning of FAA facility system improvements, the development of facility system engineering standards, the management and control of facility configurations and standards, the monitoring of National Airspace System (NAS) facility projects, and the coordination with DOD facility projects.

This task will provide wide-ranging support to AFE in the following task areas:

Facility system analysis tools
- commercial off-the-shelf software evaluation
- training products and services development
- software tools user documentation
- engineering support
- desktop mapping development support

Low cost configuration management
- development of high level requirements and planning
- automated barcoding/tagging technology feasibility analysis
- parametric CAD technology analysis
- pilot program support
- operational implementation and support

Consolidated monitor displays
- development of a detailed plan
- requirements definition
- investigation of available off-the-shelf technologies
- identification of all system interfaces
- identification of candidate display formats
- demonstration prototype design, development, and fabrication of hardware and software
- development of a system standard specification

Automated Airport Surface Lighting Control
- architecture and data studies
- developmental standards and constraints studies
- physical and environmental standards and constraints studies
- functional requirements studies
- advisory circular generation and publication
- work breakdown structure development

Task: Wake Vortex Engineering Support

The Volpe Center provides wake vortex program support to the
Federal Aviation Administration (FAA) in a number of areas,
including:

- development of vortex detection sensors

- conducting test programs to investigate vortex behavior

- performing analytical studies to determine impact of
  vortex behavior on air traffic operations

The Center is concentrating on a number of testing initiatives.
These are directed toward providing input to vortex modeling
efforts to determine the feasibility of reducing longitudinal
separations between aircraft on approach at airport with various
runway configurations and to resolve specific vortex-related
operational issues. The Center's support is directed toward
enhancement of the current understanding of vortex behavior and
the development and deployment of vortex sensors and systems to
mitigate the adverse effect of vortex behavior on airport
capacity without any adverse effect on safety. This task will
include work in the following areas:

- vortex modeling

- vortex sensors and systems development and deployment

- meteorological sensors and systems

- field test support

- vortex data analysis and database development

- air traffic control vortex procedures modification

Task: FAA Facility System Engineering Support

The Federal Aviation Administration (FAA) is engaged in
modernizing and consolidating its air traffic control buildings,
facilities, and equipment. The FAA's Facility Systems
Engineering Branch (ASD-130) is responsible for generic building
designs, facility configuration management, facility system
engineering standards, and providing technical assistance to FAA
regions in their design and configuration management activities.

This task will provide support to ASD-130 in performing the
following activities:

- developing and using a facility planning and design
  capability

- developing and maintaining facility, system, and equipment
  databases which accurately reflect current and proposed
  capabilities, configurations, and status

- providing facility design tools and associated databases
  to the regions which will integrate seamlessly with the
  ones residing at ASD

- producing generic building designs, for example, the
  Metroplex Control Facilities

- developing and using visualization capabilities to assist
  in building design and in airport layout planning

- developing and demonstrating low cost facility management
  tools for the regions

- developing and demonstrating prototype consolidated
  monitor displays for the en route centers

Task: Interface/Communications/Support for FAA's Automation
Applications Division

This task will provide support to the Federal Aviation
Administration's (FAA) Automation Applications Division (AAD) in
the following areas:

Database System - maintaining, modifying and enhancing existing
data processing and monitoring software, building and
maintaining a dynamic flight database for automatically
executing AAD's operational software at node startup time, and
for periodically purging outdated data files.

Internal Communications Software - supporting the transfer of
appropriate program files, maintenance of address lists, and
enhancements to the protocol and transparent message transfers.

Surveillance System Connectivity - implementing a single
interface a channel to NORAD for transfer of air movement data
on all air traffic from the FAA operating under Instrument
Flight Rules and Defense Visual Flight Rules.

System-wide Message Passing - providing system design,
development, and implementation of software to allow system-wide
passing of messages from any remote site to any other remote or
central site, addressing end-user processes using logical
network-wide addresses, and for providing a system status
display by polling each remote and the central site's resources.

System Consultation/Evaluation - functioning as part of the
system development team in overall system software design,
development and implementation.

Operations Support - providing 24-hour-a-day operational support
in the areas of communications, interfaces, flight database
processing, and all other Enhanced Traffic Management System
(ETMS)-related software.

External Interfaces - evaluating protocols required to support
FAA and non-FAA interfaces such as Alaska's Enroute Automated
Radar Tracking System, the Oceanic Computer System, the FAA DOTS
system, the Official Airlines Guide, the National Weather
Service, and military facilities.

Other support will include replacement of the FAA's
Interfacility Communications Network; advanced research and
development work on items such as voice recognition systems and
touch screen displays; ETMS conversion to open systems
standards; support of the Phase II enhancements of the automated
Traffic Management System known as P2E; and support of new data
ingest activities .

Task: Airport Surface Programs Engineering Support

The Volpe Center is supporting the Federal Aviation Administration (FAA) in the design, development, and implementation of the various systems which are part of the FAA's initiative in developing, improving, and enhancing airport surface traffic monitor and control. This task will provide support through the Airport Surface Traffic Automation (ASTA) Program in the following areas:

- system requirements development for new systems

- evaluation of specifications for existing systems

- comparison of commercially available systems specifications to new or existing requirements

- evaluation of modification of specifications of commercially available systems to meet new or existing requirements for surface traffic monitoring and control

- development of draft standards to guide the hardware, firmware, and software development process

- development of information requirements and a method to evaluate the effectiveness of concurrently implemented or proposed procedures

- life cycle analysis of end items manufactured, acquired, enhanced, or upgraded

- development of integrated logistics plans, logistics support analysis, spares, provisioning data, and procedures necessary to maintain systems

- evaluation of the ability of available technology to satisfy programmatic needs

- planning and feasibility of new or highly modified existing systems or subsystems

- system development to create prototype hardware and software systems

- system deployment by carrying out the installation and testing of assessment and prototype systems

Task: Weather Systems Support

The Volpe Center provides support to the Federal Aviation Administration's Runway Visual Range (RVR) Program by furnishing individuals with experience in atmospheric physics; use of meteorological sensors for measuring visibility, wind speed, wind direction, temperature, and other atmospheric conditions; and experience with forward scatter meters and transmissometers for use in measuring visibility in RVR systems. These individuals also improvise analytical and graphical techniques for extracting and reporting information from the measurement data recorded by the sensors. Also required are human factors engineers to develop test plans and procedures for human observation tests to further refine RVR equations taking into consideration factors that have not been considered in the past such as the effect of instrument panel lights in the aircraft cockpit. The RVR Program also requires field test engineers/technicians experienced in setting up data acquisition systems to collect data from multiple sensors using multi-tasking software. These systems must be remotely accessible via modems and communications software running concurrently with the data acquisition programs. The personnel need a strong knowledge of the inner workings of PC-based data acquisitions systems and some computer programming experience to integrate the system components. These skills are required in order to set up data acquisition systems at airports and other remote sites.

The Center provides support at a weather test facility where personnel maintain various reference sensors for the major meteorological parameters and take weather observations.

Assistance is also given to the FAA for the Automated Lightning Detection and Reporting Systems (ALDARS). This system receives and processes National Lightning Detection Network (NLDN) data within the Automated Weather Observing Systems (AWOS) Data Acquisition System (ADAS) computers at FAA air traffic control centers. Support includes :

- developing the algorithm for converting NLDN data into voice/text messages for broadcast by AWOS

- comparing NLDN-based thunderstorm alerts and surface observations taken at airports with what was reported by trained weather observers

- modifying software written by the FAA to simulate NLDN functions and assisting in modifications to the ADAS software to implement ALDARS in the operational ADAS system

Task: Interface/Communications/Support

The Federal Aviation Administration's (FAA) Traffic Management System (TMS) applies traffic management procedures to help maintain safety in the National Airspace System (NAS) and to balance the traffic loads within system capacities. The Volpe Center has supported the FAA's TMS programs for over the past 10 years. This task augments the volpe team supporting this work. One such program, the Advanced Traffic Management Systems (ATMS), is a research, engineering and development program instituted by the FAA for the purpose of applying new technology to solve air traffic management problems. ATMS development has emphasized the application of rapid prototyping techniques to develop software based upon new air traffic management concepts, and the Center has been the major contributor to the ATMS by developing tools such as:

- The Aircraft Situation Display (ASD) which displays current location of all controlled aircraft flying throughout the U. S. and over oceanic routes.

- The monitor-alert function which predicts when air traffic demands will exceed specified thresholds for fixes, sectors and airports over time periods extending up to eight hours into the future.

- The Automated Demand Resolution (ADR) function to provide gate holding and rerouting capabilities.

The other FAA TSM program receiving support from the Volpe Center is the operational Enhanced Traffic Management System (ETMS). Once ATMS software, databases and documentation produced by the Center are tested, evaluated and accepted by the FAA, they are implemented as part of the operational ETMS. Some features of ETMS are the ability to process large amounts of near-real-time air traffic information; updating live air traffic data consisting of flight plans, departure messages, and radar tracking positions every five minutes as well as transmitting arrival messages; and providing computer simulations of each flight route in detail and projecting the future flight location times by receiving live data and continually updating projections based on the new information.

Besides working with the FAA, the Volpe Center supports the U.S. Air Force by assisting with the North American Air Defense Command's (NORAD) Automated Air Movement Data System (AAMDS). This system is responsible for the timely and reliable receipt of data used for the identification of aircraft well prior to the penetration of the designated surveillance areas in the Air Defense Identification Zones.